

Article Last Updated: 10/03/2005 04:21 AM

colorado's oil shale industry series: part I

Oil riches just out of reach

Shell leads push on shale. Rising crude prices boost hopes for the success of inserting heating rods into layers of rock to extract the West's estimated reserves of 1 trillion barrels.

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The Associated Press
DenverPost.com

Meeker - Out in sagebrush country, Kenneth Brown is standing over part of the world's most concentrated energy resource, land that holds up to 1 million barrels of oil per acre.

Too bad it's locked up in layers of rock in some places hundreds of feet underground.

Such is the dilemma presented by the West's oil shale reserves, believed to contain more than 1 trillion barrels of oil - four times the holdings of Saudi Arabia, according to government and industry estimates.

The problem is extraction: Underground layers of shale are as thick as 1,000 feet and were deposited over millions of years by an algae-producing sea. The Green River formation is potentially the world's most bountiful energy source - enough in theory to meet U.S. energy needs for a century - but it is an expensive nut to crack for energy companies. Plus, it could use up a lot of water in an arid region.

Shell Exploration & Production Co. has been out here for nine years, trying to bake shale oil from the ground by using heating rods drilled into layers of rock.

"Things have progressed well in the last two years, which makes us feel good," said Brown, operations manager for Shell's closely guarded experiment in the middle of desolate Rio Blanco County, about 60 miles from tiny Meeker, the nearest town.

Shell pumped 1,400 barrels of oil last year from this test plot tucked under a high ridge, the better to keep it out of view of industrial spies. Shell is done producing oil for now and planning another test as it takes government officials and environmental advocates out to the site, a gravel platform not much bigger than a basketball court.

This is ground zero for the latest push to unlock shale oil, sometimes called the energy of the future. Skeptics say it always will be the energy of the future - a mirage that has led to disappointing economic results for the better part of a century.

Yet oil shale is looking more attractive: The price of crude is holding above \$60 a barrel, the government is offering oil-shale leases again, the latest energy bill offers tax incentives and companies are deploying new technology.

Technological hurdles remain daunting, but that hasn't stopped "people with a gleam in their eyes," said Robert Hirsch, a senior energy adviser for San Diego-based Science Applications International Corp. "I think Shell has something that could turn out successful. They've been working on this technology for a long time." The Energy Department thinks so, too. In a report last year, it called Shell's technology the most promising but said it will take a "massive capital investment" to unlock Western oil shale.

Canada has been developing Alberta's tar sands for 35 years but only about 10 percent of a reserve estimated to contain 1.6 trillion barrels of oil is considered recoverable.

Oil shale last enjoyed fleeting fame in the United States in the 1970s, when oil prices skyrocketed. The industry was abandoned by the early 1980s and had its own Black Sunday in 1982, when Exxon shut down its \$5 billion Colony project in western Colorado and laid off 2,200 workers.

This time around, energy companies are more optimistic about coaxing petroleum out of the rock - an immature form of oil not fully cooked by the Earth. Once it is, experts say Western shale can produce a high-quality petroleum prized for its use in jet fuel.

One of Shell's biggest problems has been the heating elements that roast the ground hot enough to release a light crude oil, which can be pumped to the surface from conventional wells.

Natural ground movement tends to crush the oven-like elements, and lightning has shorted them out. It also takes four to five years and a lot of power to heat up the underground to temperatures around 650 degrees.

Shell believes it can make this technique economical as long as crude oil stays above \$30 a barrel, but it is five years away from proving the technology or deciding whether to build a commercial-scale operation, said Terry O'Connor, a company vice president for external and regulatory affairs.

Steve Smith, assistant regional director of The Wilderness Society in Denver, said he was impressed with Shell's technology, its approach and concern for the environment.

"I'm still skeptical that something so complicated will actually work," he said. "That's before you ask questions about where they are going to get four barrels of water for a barrel of oil in an arid region." The water is mostly needed for work camps, new communities and for land restoration, but Shell says it hasn't determined how much water would be needed per barrel of oil.

Outside Vernal, Utah, officials with Oil-Tech Inc. are working on another technique to extract oil from shale. They say they have perfected an older technology of baking oil from shale in a furnace without gumming up the works, which has long frustrated the efforts of major oil companies. Privately held Oil-Tech wants government approval to mine 1,600 acres of state land and access to 30,000 tons of shale at an abandoned mine.

"We're ready to go as quick as we can get a mining permit and a few bucks," said Byron Merrell, a 63-year-old inventor and stockholder in Oil-Tech.

Environmental advocates say Oil-Tech's concept invokes a horror movie - vast strip mines dotted with belching furnaces. Merrell counters that his electric furnace releases no combustion emissions. The process, however, would leave piles of waste a third larger in volume than the shale fed into the furnace, due to the "popcorn" effect of pulverizing hard rock.

Oil-Tech believes it can produce a barrel of oil less than \$30, company director Jack S. Savage told a congressional hearing in June.

The methods used by Oil-Tech and Shell have drawbacks, said Jim Bunger, a former chemical engineering professor at the University of Utah. Now chief executive of the petroleum research firm James W. Bunger & Associates, he said Oil-Tech's technology is unproven and the mining could scar the land and leave huge piles of waste.

"I don't think they're as far along as they think they are," he said.

Bunger helped write the U.S. Energy Department report issued last year that said Shell may have a problem with lingering groundwater contamination at its spent cook sites. He questioned Shell's estimate that it can economically recover shale oil for as low as \$30 a barrel.

To address the environmental problem, Shell broke ground on a larger test site the size of a football field. Shell engineers will spend two years trying to maintain an underground "ice curtain" with refrigerated pipes around a cook site to repel groundwater and keep oil from slipping away. Shell also has applied for a federal land lease with the goal of producing upward of 1,000 barrels a day from a more productive site. "This is purely an environmental test. We need to have a higher level of confidence this freeze-wall technology can work on a larger scale," O'Connor said.

Layers of frustration

Oil shale recovery has had a long and frustrating history in the American West. Here are some of the key moments.

1909: The U.S. government sets aside rich oil shale lands in western Colorado, creating the U.S. Naval Oil Shale Reserve.

1917: Ranchers build the first oil shale retort kiln in De Beque, Colo.

1918-25: More than 30,000 mining claims are staked, marking oil shale's first boom.

1929: The U.S. Bureau of Mines extracts 3,600 barrels of oil from an experimental retort at Rulison, Colo. Production stops when liquid oil fields are discovered in California, Texas and Oklahoma.

1961: Unocal Corp. shuts down a retort in Parachute, Colo., after 18 months because of operational problems and price uncertainties.

Early 1970s: Royal Dutch Shell experiments with, then abandons, a steam-injection process in Rio Blanco County, Colo.

1966-77: A partnership of 17 companies and the U.S. government operates a secret Anvil Points retort near Grand Junction to produce oil for the Navy. Operational problems and costs force a shutdown, leaving a pile of oil shale 1,000 feet long and 350 feet high contaminated with heavy metals such as arsenic. Other energy companies try to improve oil shale recovery methods during this time but get little from the efforts.

1974: Several oil companies lease federal lands for Exxon's Colony oil shale project near Parachute.

1976-78: The price of crude oil reaches \$41 a barrel.

1980: Congress appropriates \$14 billion for development of synthetic fuels, giving Colony a boost.

1982: Oil demand and price drops. Exxon shuts down Colony successor project before it can become fully operational, triggering an economic bust in Colorado.

1985: Congress abandons the Synthetic Liquid Fuels program after spending \$8 billion over nearly 40 years.

1986-87: The U.S. government sells some oil shale lands, with Shell picking up 17,300 acres in Rio Blanco County.

1997: The Energy Department gives control of most of the Naval Oil Shale Reserve in Colorado to the Bureau of Land Management. Shell experiments with ground heating in Rio Blanco County.

1991: Unocal abandons the last domestic effort to produce oil shale on a commercial scale, near Parachute.

2000: Shell revives its Mahogany oil shale project.

2005: Crude oil tops \$60 a barrel; new energy legislation instructs the BLM to lease 5,200-acre tracts for oil shale development within three years.

Sources: Shell Exploration & Production Co.; U.S. Department of Energy; Associated Press archives